Accelerating Growth of Technology Transfers from CSIR-CSIO

DR. RITIKA SINGH

A premier national laboratory dedicated to research, design and development of scientific and industrial instruments, CSIR-CSIO has contributed substantially towards the growth of the scientific instruments industry in the country, generating revenue from the commercialisation of the technologies. A few technologies recently commercialised by it are discussed here.

CSIR-Central Scientific Instruments Organisation is a premier national laboratory dedicated to research, design and development of scientific and industrial instruments. Having contributed substantially towards the growth of the scientific instruments industry in the country, CSIR-CSIO enjoys high degree of credibility among the users of the instruments as well as the instrument industry. It is a multi-disciplinary and multi-dimensional apex industrial research and development organisation in the country to stimulate growth of instrument industry in India covering wide range and applications. It has over the years created its visibility in agrionics, bio-medical engineering, optics & photonics, analytical instrumentation, public safety and security gadgets of relevance to the general needs of society apart from niche areas in defence in terms of cockpit instrumentation such as head-up display and its different variants.

CSIR-CSIO is an autonomous body which follows a robust business model for sustenance. It has shifted its focus from generating only intellectual property to also generating revenue from the commercialisation of the technologies to sustain its activities. In the recent years, CSIR-CSIO, equipped with indigenously built technologies and business acumen, has given boost to the Indian industry by focussing on the commercialisation of these technologies and has helped in saving the foreign exchange. This article provides a glimpse of the technologies transferred in the last couple of years with a brief description of the technological advances achieved by it to benefit the Country and society at large.

Bore Sighting System (BSS) is a harmonisation equipment used to install and harmonise Head-up Displays, Gun Sights, Bore Sighting Tool for Laser Ranger & Marked Target Seeker, SPA Payloads and similar systems at the desired position in the aircraft cockpit. The BSS substitutes the actual

Bore sighting system

Farmer using air-assisted electrostatic sprayer

display system for the purpose of aligning the mounting mechanism with reference to the aircraft axis (Fuselage Reference Line – FRL). Once the mounting mechanism tray/mechanism is harmonised, interchangeability of display is ensured within tolerance specified in mR.

The technology can be custom designed quickly for any aircraft platform to ensure correct harmonisation of HUD and similar systems in the aircraft cockpit owing to its modular design and construction. Its indigenisation has saved several crores of foreign exchange and its unique design ensures precise harmonisation while its modular design provides an option to customize the design further if required. Presently, the BSS technology custom designed for LCA-AF platform has been transferred to Bharat Electronics Limited, Ministry of Defence, Panchkula.

There is a pressing need for eco-friendly and efficient device for spraying pesticides on crops, orchards and trees, especially in the cotton growing states to stop the damage to crops. The conventional and outdated spraying techniques and equipment result in many problems such as high volume but low efficiency of the pesticides deposited on the targets, most of the pesticide lost in the surroundings due to off-target spray drift, causing contamination to soil, water and eco-system which results in human health risks, and serious environmental pollution. To overcome these limitations, a new low-cost air-assisted electrostatic nozzle has been designed and developed especially for rural agricultural sector. Electrostatic spraying technology offers a very favourable approach to increase pesticide droplet deposition onto surfaces of crops and orchards with two-fold mass-transfer efficiency of active ingredients of pesticides. This nozzle is light-weight, and reduces pesticide use and human health risk. An air-assisted electrostatic nozzle is a blend of an air-assisted nozzle and induction based electrostatic charging system. Spray droplets are electrified to more than 10 mC/kg charge-to-mass levels by a charging voltage less than 2.0 kV, and electric power consumption less than 75 mW. It can be used with all liquid-based pesticides with full charging efficiency. The technology has been transferred to Jagatsukh Industries, Ludhiana. Later, an advanced version of it was transferred to Dashmesh Industries, Alwar, Rajasthan. The technology has attracted many new companies who have shown their desire to acquire it.

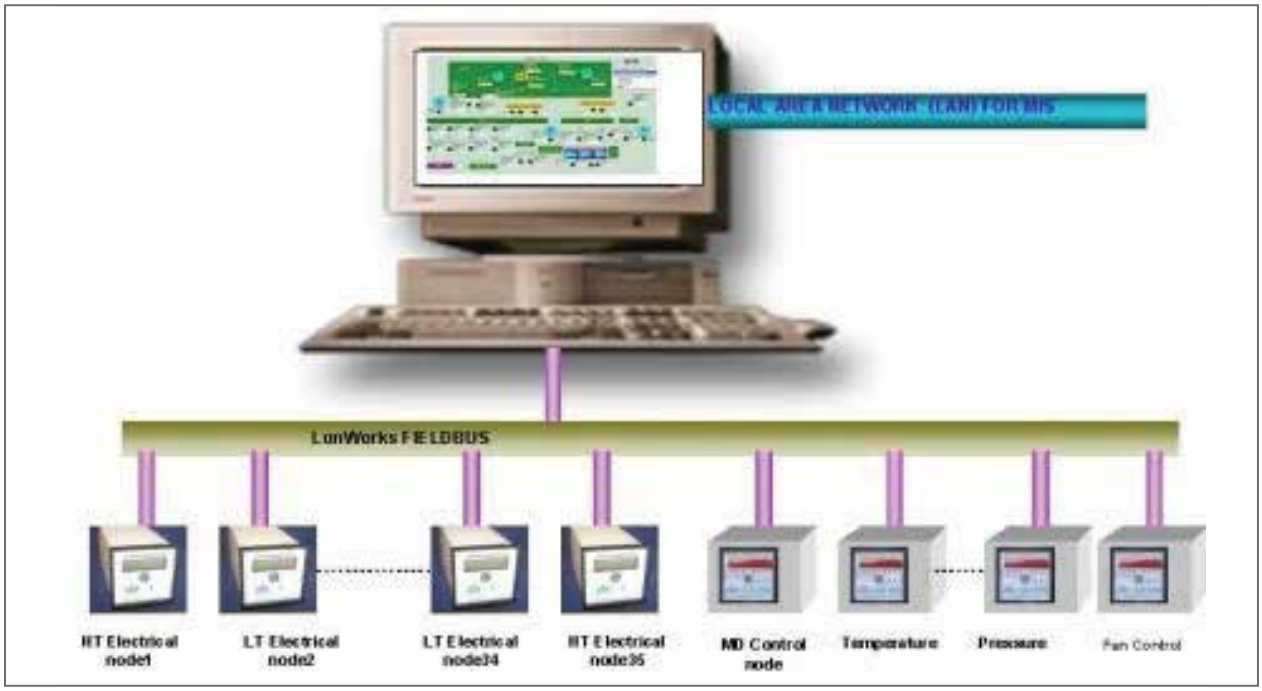
Food security is an important concern for every country and more so for India because of its burgeoning population. India suffers crores of rupees due to post-harvest losses every year. Moisture content in grain is an important parameter which controls shelf life of the stored grains and is mainly responsible for mould growth, spoilage, etc. The Digital Grain Moisture Analyser (DGMA)

Digital grain moisture analyser

Foot controlled water tap – Jal Brand

developed by CSIR-CSIO can be used at different stages of grain harvesting, procurement, storages and food processing industries, etc., to ensure right quality and preservation of quality. It is based on capacitance variation technique. The instrument comprises of mainly an analog section and a digital section. For controlling the complete functioning of DGMA, it uses power-efficient, high-speed microcontroller (MCU) chip. The sensing system is made up of capacitive transducer that converts the moisture content into an electrical signal. Presence of a very small quantity of water causes considerable change in the dielectric constant of the sensor cell. These moisture variations change capacitance and in turn are measured in terms of frequency variations. These variations are then further trend-fitted and calibrated in terms of percentage moisture. The final result in terms of moisture percentage, temperature of sample, date and time of measurement is displayed on an LCD screen for a given sample under measurement. CSIR-CSIO has transferred the technology for Digital Grain Moisture Analyser to K.C. Engineers, Ambala Cant. An advanced version of it Impedance-based Grain Moisture Analyser (IGMA), which rapidly detects moisture levels on the spot without any need for chemical analysis, has been transferred to M/s. R.L. Wason & Co., Jalandhar for its indigenous production.

Foot Controlled Water Tap is an innovative mechanism that allows the water tap to be controlled by foot unlike the conventional means of controlling it by one's hand, avoiding contaminants depositing on the tap. It is highly recommended that public places such as hospitals, schools, public toilets, malls, restaurants and railway stations have this kind of foot-controlled water tap than the traditional technology which is prone to secondary mode of germ transfer. Further, this technology does not require any electrical supply and can be easily integrated with the existing systems without modifying any civil installation. This technology



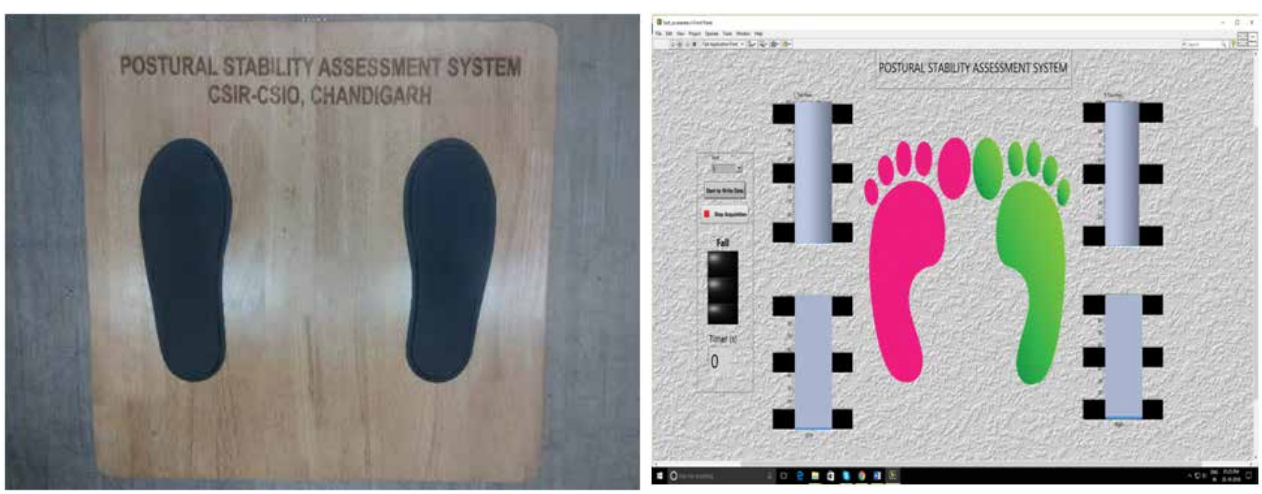
Energy management system

Technology for separation of phosphor from CFL waste

is aligned with the Swachh Bharat and Swasth Bharat campaign of our Prime Minister and also helps in saving the water resource. The technology was transferred to Aqua Systems Pvt. Ltd., Mohali. This product will be marketed under the JAL brand and company will also get this product registered as a green product.

With the ever-increasing demand of electricity for modernisation, industrial expansion, etc., Energy Management System is considered to be a pre-requisite for achieving sustainable energy savings in industries, commercial establishments, high-rise buildings, etc. The Energy Management System (EMS) developed by CSIR-CSIO acquires data from different energy consuming areas in various sections of the plant and logs the information and generates reports. This information can be used for taking actions leading to improvement in energy efficiency. RS485 with MODBUS protocol has been adopted for energy monitoring and control in a small/medium scale industry. Network nodes have been developed for providing comprehensive electrical energy measurements as well as physical parameter measurements. CSIR-CSIO Energy Management System developed by its Chennai Centre has been transferred to Smart Metering Energy Solutions LLP, Panchkula. Along with this CSIR-CSIO has also developed Induction Motor Efficiency Monitoring System, which displays the operating efficiency of motor by monitoring the electrical power input (like voltage, current and power) and shaft speed of the motor. The technology has been transferred to Beta Technologies India Pvt. Ltd., Coimbatore.

The problem of solid waste accumulation from spent consumer electronics is increasing day by day. Most of the recycling technologies do not necessarily yield economically viable products because of which this sector has not attracted many investors. Scientists at CSIR-CSIO have successfully demonstrated the conversion of zinc scrap. The process not only involves safer chemical steps but also converts the zinc waste into a high-cost product, 2-methylimidazolate zinc salt, commonly known as ZIF-8. The whole process uses simple



Postural stability assessment system

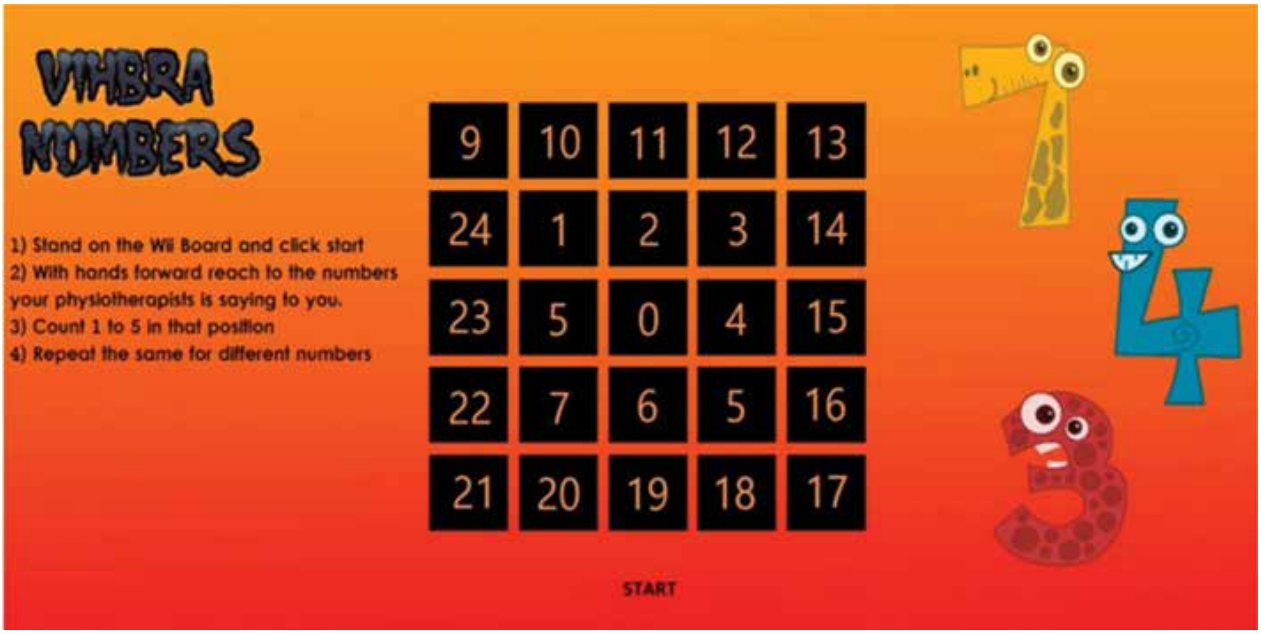
Myo-meter

leaching and hydrothermal steps. At present, the commercial price of the recovered product is around ₹8 lakh/kg. The underlying economic benefits of the developed technology speak about the significance of this Waste-to-Wealth opportunity for the recycling industries. The technology has been transferred to Intelligent Materials Pvt. Ltd., Chandigarh.

There is a pressing need for the recycling of waste CFLs as they are fast turning up huge amounts of solid waste both in urban and rural areas. The recycling technology that CSIR-CSIO has developed for the separation of phosphor material from CFL waste will enable the industry to safely separate the different components in the form of further marketable products. The process will also contribute towards the environmental protection. The technology has been transferred to Exigo Recycling Pvt. Ltd., New Delhi.

Apart from this, another technology which was transferred is the Postural Stability Assessment System. It was transferred to Medicad Systems, Chandigarh. Postural stability is achieved by maintaining an upright body alignment against gravitational force and preserving the equilibrium of the centre of mass in an individual's base of support. The system uses successful postural control, which requires the contribution from a complex sensory system comprising visual, somatosensory, and vestibular modalities as well as motor control systems. Ground reaction forces are amongst the prominent parameters used for gait assessment. It gives an approximation of the projection of body's centre of mass on the ground. Gait events like balance stability and lateral fall is detected. Compact module packaging makes it comfortable in wearing and does not interfere in natural movements. Real-time ground reaction forces from all the sensors and centre of foot pressure has also determined.

Myo-Meter is a device used to test the human muscle functionality in real time. CSIR-CSIO has transferred this technology to M/s. LM Healthcare, Panchkula. Myo-Meter is a handy



Virtual rehabilitation – VIHBRA

Exoskeleton device

device which is used to find out the optimum location of the EMG electrodes placement for the proper functioning of the myoelectric arm. It shows the real-time functioning of the muscles by showing strength of the EMG signal produced by the muscles during relaxation and contraction.

VIHBRA-Virtual Intelligence in Home Based Rehabilitation is a virtual intelligent platform for motor rehabilitation was developed in the CARE Lab. VIHBRA combines experience from virtual reality and knowledge from machine intelligence to enhance neural reorganisation that optimises the physical rehabilitation outcomes in patients with disability. It provides stimulating sensory feedback to promote motor learning and encompasses tools that help to understand the biology of disability. The system integrates inexpensive devices like Microsoft Kinect and Wii Balance Board to improve balance and neuromuscular functions. Quantification of motor disability is done through presenting the individuals with situations/ tasks that require use of groups of muscles and body parts like an augmented rehabilitation measure such as Virtual Function Reach

Virtual rehabilitation – VIHBRA

Touch based finger gesture controlled intelligent patient vehicle

Test. The developed system has been installed at Prayaas Rehabilitation Centre for Handicapped Children in association with Post Graduate Institute of Medical Education and Research and Indian Spinal Injuries Centre, New Delhi for clinical evaluation and use. CSIR-CSIO has transferred the technology to Walnut Medical Pvt. Ltd., Ambala City.

Exoskeleton Device belongs to the category of wearable robotics and was developed in the GAIT Lab. An exoskeleton is an external structural mechanism with joints and links corresponding to those of the human body. CSIR-CSIO has transferred the technology to Pentagon Rugged Systems Pvt. Ltd., Hyderabad.

Due to the absence of care-givers, currently available mobility solutions needs to be upgraded using alternative drive controls to help make independent mobility possible. The proposed technology, Control Module For Touch-Based Finger Gesture Controlled Intelligent Patient Vehicle developed in the Bio-Medical Division is meant for empowering weak upper limb paraplegics/elderly subjects who cannot hold the normal joystick with ease and require manoeuvring their powered mobility device or wheelchair independently without any need of care givers all the time. It consists of a touch-screen proportional controller that requires no force to activate and drive. Making contact with the screen activates the device, and maintaining contact enables full driving capabilities. The technology has been transferred to Pentagon Rugged Systems Pvt. Ltd., Hyderabad.

Electronic Knee is an intelligent prosthetic device for trans-femoral (above knee) amputees which will be manufactured for the first time in India by an Indian company, Walnut Medical Pvt. Ltd., Ambala City. The device has built-in microcontroller and sensors and assists persons involved in activities requiring high level of stance stability. For adaptive gait, the knee adapts to patient movement style in real time

with the integration of indigenously developed electro-goniometer, force-resistive sensor and accelerometer in order to control the swing phase dynamically. Three variants (Electronic sensor, Remote and Mechanical) of knee have been developed. The cost of the Electronic Knee is about ₹40,000, which is low as compared to imported knee which starts at about ₹5 lakh. With the help of this device the amputee can walk at different speeds as desired at less effort.

Diffraction Lloyd Mirror Interferometer is an innovative modification in the well-known Lloyd's mirror interferometer, making it more suitable for studies on interference as well as diffraction of light. In this new interferometer a diffracting element is used to diffract the light from the point source and a Lloyd's mirror is used to generate interference fringes by overlapping two portions of the diffracted wave front. Since in this case both the interfering waves are diffracted waves having their origin on the boundary of the diffracting aperture and a Lloyd's mirror is used to produce interference fringes, the configuration is called as Diffraction Lloyd Mirror Interferometer in analogy with the geometrical Lloyd's mirror interferometer. The new interferometer not only produces additional interference fringes in the geometrically shadow region but is also very much suitable to explain the process of diffraction of light. The interferometer is capable in generating different shapes of the fringes in a single interferometer, which is not possible in any of the existing interferometers. It is the only interferometer worldwide which can generate straight, conic and circular fringes in single interferogram. It verifies and establishes the validity of Young's theory of boundary diffraction wave. Interference and diffraction are main optical processes underlying the important area of communication, sensing, imaging, etc. This technology has been transferred by CSIR-CSIO to Maffick Instruments, Ambala City.

Diffraction lloyd mirror interferometer

Electronic knee

CSIR-CSIO endeavours successful technology transfer in future as well. It believes in providing quality and user-friendly instrument prototype to the industry. It has dedicated teams of scientists and technicians working on the projects. It wants to provide event solutions and not just stand-alone systems. In essence, CSIR-CSIO is leading the instrumentation industry to build an economically strong nation with a promise of high quality of life for its people.

(Acknowledgement: The author is grateful to the Project Leaders of the above technologies, Head BIPP, Administration and Director CSIR-CSIO for providing the opportunity to publish the article).

Dr. Ritika Singh, Senior Scientist, Business Initiatives & Project Planning (BIPP), CSIR-CSIO, Chandigarh
E-mail: ritikasingh.ism@gmail.com